Environmental Risk of Acetate-Based Lepidopteran Pheromones

LBAM Environmental Advisory Task Force
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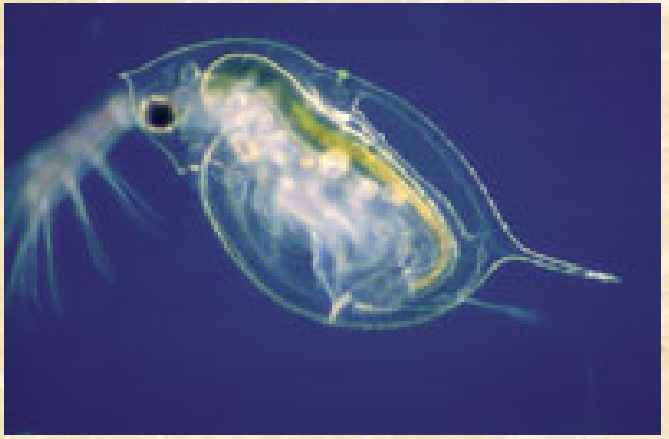
Evaluation Procedure for Ecological Risk Assessment

- Assumes risk is a function of toxicity and exposure
- Risk Quotient (RQ) = Exposure /Toxicity Endpoint
- RQ compared to levels of concern (LOC's)



Which Chemical Poses the Greatest Risk?

- Chemical A:
  - Fish LC_{50} = 4 ppb
  - Exposure = 0.5 ppb
  - **Risk = 0.5/4 = 0.12**
- Chemical B
  - Fish LC_{50} = 4 ppm
  - Exposure = 5 ppm
  - **Risk = 5/4 = 1.25**

Surfactant Use and Checkmate

- Reported bird die-offs attributed to a protein-based material with "surfactant-like" properties
- No surfactants in the formulated material
- No surfactants used in mixing for application per label instructions
- CA Fish and Game report concluded no link to LBAM applications

Pheromone Terrestrial Vertebrate Toxicity

Test Species	Exposure Route	Toxicity Value
Bobwhite/Mallard	Oral	LD_{50} > 2 -10 g/kg
Rat	Oral	LD_{50} > 5 - 34 g/kg
Rat	Dermal	LD_{50} > 2 - 25 g/kg
Rat	Inhalation	LC_{50} 3 - 33.2 mg/L LC_{50} 3 - 33.2 g/m^3

Terrestrial Exposure to Pheromones

- Determine residues based on direct application to food items
  - Herbivores, granivores, insectivores
  - Different size classes for each taxa
  - Assume broadcast liquid applications of pheromone
  - No degradation or volatilization
- Mammals: 0.02 to 10.07 mg/kg
- Birds: 0.19 to 12.03 mg/kg

Pheromone Risk to Terrestrial Organisms

- Levels of Concern (LOC)
  - Risk Quotient (RQ) = Exposure / Toxicity
  - LOC Endangered mammals and birds (0.1)
  - RQ for birds: 12.03 mg/kg / > 2 g/kg
    - RQ = **< 0.006**
  - RQ for mammals: 10.07 mg/kg / > 5 g/kg
    - RQ = **<0.002**

Inhalation Exposure Assumptions

- All of the pheromone from the application is available for inhalation
- All pheromone is available within 2-m from the ground (ie. Application height = 2 m)
- Mammalian and avian inhalation toxicity is similar
- Maximum Exposure 1.85 mg/m^3

Pheromone Inhalation Risk to Select Terrestrial Non-Target Organisms

Species	Inhalation Rate (m^3/day)	Maximum Inhalation Dose (mg/day)	Inhalation Toxicity Value (mg/m^3)	Risk Quotient
Deer Mouse	0.025	0.05	3000	**0.00002**
Cottontail	0.63	1.17	3000	**0.0004**
Red Fox	2.0	3.7	3000	**0.002**
Belted Kingfisher	0.094	0.17	3000	**0.0006**
Western Gull	0.48	0.89	3000	**0.0003**
Bald Eagle	1.43	2.64	3000	**0.0009**

Maximum Inhalation Dose = Inhalation rate (m^3/day) * 1.85 mg/m^3)

Pheromone Aquatic Toxicity

Test Species	**Toxicity Value**
Rainbow Trout	LC_{50} > 100 - 270 mg/L
Bluegill Sunfish	LC_{50} > 100 - 540 mg/L
Daphnia magna	EC_{50} = 1.30 - 6.80 mg/L

* Values exceed solubility.

LBAM Pheromone Aquatic Toxicity

- Formulated Pheromone: Dosing based on direct application data
  - *Mytilus galloprovincialis* : No effects based on average and maximum number of microcapsules observed in first application w/n spray block
    - September 07: Average = 36 microcaps/sq ft; maximum 265
  - *Ceriodaphnia dubia*: No effects based on average and maximum number of microcapsules observed in second application
  - Fathead minnow: No effects based on average and maximum number of microcapsules observed in second application
    - October 07: Average = 114 microcaps/sq ft; maximum 809

- Technical Pheromone:
  - *Ceriodaphnia dubia*: no effects at 12 and 24 ppb; 100% mortality at 100 to 400 ppm
  - Fathead minnow: no effects at 12, 24 and 48 ppm
    - Santa Cruz application: 52,000 acres
    - Entire amount of pheromone from the Santa Cruz application into a two acre pond is approximately 53 ppm

Pheromone Exposure to Aquatic Organisms

- Direct application at the maximum rate into a closed body of water 12 inches deep
- Body of water has no inlet/outlet
- All of the material is soluble
- None of the material degrades
- Material applied as technical material
- Estimated Aquatic Residue = 0.012 mg/L

Technical Phermone Risk to Aquatic Receptors

- Levels of Concern (LOC)
  - Risk Quotient (RQ) = Exposure / Toxicity
  - LOC Endangered aquatic organisms (0.05)
  - RQ for fish: 0.01 mg/L / > 100 mg/L
    - RQ = **< 0.0001**
  - RQ for invertebrates: 0.01 mg/L / 1.30 mg/L
    - RQ = **0.009**

Summary

- Based on unrealistic exposure scenarios and available toxicity data the pheromone poses negligible oral and inhalation risk to non-target birds and mammals
- Based on unrealistic exposure scenarios and available toxicity data the technical and formulated pheromone poses negligible risk to fish and aquatic invertebrates